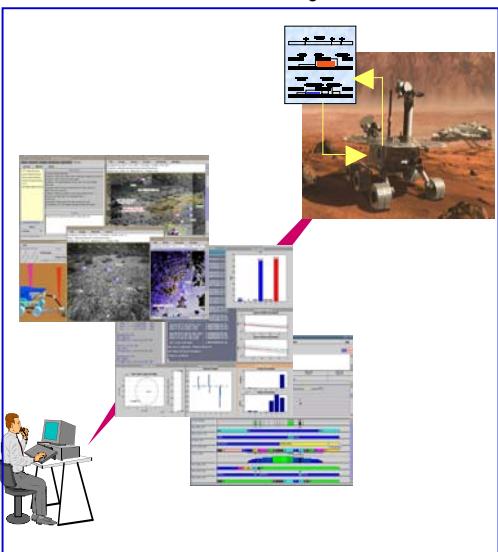


Significant Technology Program Infusions Since 1995 (Partial List)

Communication Systems



Information Systems



Spacecraft hardware:

- Motorola X/ Ka-band Small Deep Space Transponder (SDST) - DS1, Mars Odyssey, Mars Exploration Rover (MER) (03), Mars (05), others
- Ka-band 35 W TWTA - Anticipated use on Mars 05
- Micro Communications and Avionics System (MCAS) - Used as basis for Mars 05 ELECTRA payload

Ground Antennas:

- Low loss diplexed feeds for improved 2-way communication - DSN
- Ka-band radio science receiver (RSR) - DSS 25 Cassini Gravity Wave Experiment (GWE)
- Ka-band monopulse feed - DSS 25 closed loop antenna pointing

Coding:

- Turbo code theory, specific codes, encoders, and decoders - DSMS Engineering infusing into DSN for all missions

Atmospheric Calibrations:

- Advanced Water Vapor Radiometers (AWVR's) - DSN; Cassini GWE

Data Compression:

- Wavelet-based Image Data Compression Entropy Encoder (ICER) - Selected for MER

Frequency Standards:

- Linear Ion Trap Standard (LITS) frequency standard - DSN; DSS 25 Cassini GWE
- Cryogenic Sapphire Oscillator (CSO) - DSS 25 for Cassini Saturn ring occultation measurements

Tracking System and GPS:

- GPS-based orbit determination - SRTM (00), SAC-C (00), Champ (00), JASON-1,2 (01,04), GRACE (02)
- Global GPS-based Earth platform determination - DSN
- Autonomous Formation Flyer (AFF) - Planned for Starlight (06)
- Delta Differential One-Way Ranging (DDOR) - DS1, Mars Odyssey, MER, Deep Impact (04), Mars (05)
- Internet-based Global Differential GPS (IGDG) - GPS-based media calibrations for the DSN sites

Communications Protocols:

- CCSDS File Delivery Protocol (CFDP) - MER, Deep Impact, Mars missions

Automation/Autonomy:

- Automated Radio metric Data Visualization and Real-time Correction System (ARDVARC) - (98)
- Automated Multiple Maneuver Optimization (AMMO) - Stardust ; baseline for next generation navigation software
- ASPEN Automated Planning/Scheduling System - Modified Antarctic Mapping Mission (MAMM)
- Automated command execution - DSN
- Beacon Monitor Operations Experiment (BMOX) - DS1 (98)

Data Visualization:

- Sense of Active Presence terrain generator - Mars Pathfinder, Mars 98
- SUMMITT - selected for use with MER project

Mission Planning:

- Web-based Collaborative Distributed Planning (WITS) - selected for use with MER